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Pflug, I. J.: (2010). Science, Practice and Human Errors in Controlling Clostridium botulinum in Heat-Preserved Food in Hermetic Containers. J. Food Protection, 73(5):993-1002.

### Abstract

The incidence of botulism in canned food in the last century is reviewed along with the background science; a few conclusions are reached on the basis of an analysis of published data.

There are two primary aspects to botulism control: the design of an adequate process and the delivery of the adequate process to cans of food. We conclude that botulism incidents in canned food are primarily the result of human failure in the delivery of the designed or specified process to cans of food that, in turn, results in the survival, outgrowth, and toxin production of *C. botulinum* spores. It is possible but very rare to have botulism result from post processing contamination.

The probability that the designed process will be inadequate to control *C. botulinum* is very small, probably less than  $1.0 \times 10^{-6}$ , on the basis of cans of food, whereas the failure of the operator of the processing equipment to deliver the specified process to cans of food may be of the order of one in 40 to one in 100, on the basis of processing units (retort loads). In the commercial food-canning industry, failure to deliver the process will probably be of the order of  $1.0 \times 10^{-4}$  to  $1.0 \times 10^{-6}$  when FDA regulations are followed. Botulism incidents have occurred in food canning plants that have not followed the FDA regulations.

It is recommended that our efforts in *C. botulinum* control be concentrated on reducing human errors in the delivery of the specified process to cans of food.